Pest Management FAST FACTS

Nutrient and Pest Management Program (NPM)
Integrated Pest Management Program
University of Wisconsin-Extension, UW-Madison

Avoid Herbicide Resistance in Weeds

Use herbicides only when necessary to prevent economic loss. Base herbicide use on the species present or expected, and their density.

Rotate or tank mix herbicides. Rotate herbicides among different modes of action or use tank mixtures of different modes of action.

Rotate crops. Where possible use crops with different life cycles. For example, rotate corn with winter wheat (a winter annual) or alfalfa (a perennial).

Use mechanical weed control methods. Rotary hoe and cultivate to complement herbicide treatments.

Scout fields regularly for weeds. Respond quickly to increases in weeds with suspected herbicide resistance.

Signs of Herbicide Resistant Weeds

1. Only one species has escaped control.
2. There were no herbicide application errors.
3. The environment was favorable for good herbicide performance.
4. Respraying did not control the weed.

Resistant Weeds in Wisconsin (2004)

Weed species	Mode of action (herbicide*)
Velvetleaf	Photosystem II (atrazine)
Smooth pigweed	Photosystem II (atrazine)
Common lambsquarters	Photosystem II (atrazine)
Kochia	Photosystem II (atrazine) & ALS inhibitors (Oust)
Common waterhemp	ALS inhibitors (Pursuit)
Green foxtail	ALS inhibitors (Raptor)
Shattercane	ALS inhibitors (Accent)
Giant ragweed	ALS inhibitors (FirstRate)
Eastern black nightshade	ALS inhibitors (Pursuit, Raptor)
Large crabgrass	ACCase inhibitors (Fusilade, Poast)
Giant foxtail	ACCase (Fusilade, Poast) & ALS inhibitors (Pursuit, Accent)

* References to pesticide products in this publication are for your convenience and are not an endorsement of one product over other similar products.

Surface Area calculations:

Rectangular Area = Length x Width

Triangular Area = ½ x (Base x Height)

Circular Area = 3.14 x Radius^2

Websites with Pest Management Information:

UW Integrated Crop and Pest Management:
http://ipcm.wisc.edu

UW Wisconsin Crop Manager:
http://ipcm.wisc.edu.wcm

University of Wisconsin – Extension publications:
http://cecommerce.uwex.edu

Crop Data Management Systems, labels and MSDSs:
http://www.cdms.net

Conversions for small liquid volumes

1 teaspoon = 0.169 fluid oz
3 teaspoons = 0.5 fluid oz
1 tablespoon = 0.5 fluid oz
2 tablespoons = 1.0 fluid oz
2 fluid ounces = ¼ cup
4 fluid ounces = ½ cup
8 fluid ounces = 1 cup
32 fluid ounces = 1 quart
128 fluid ounces = 1 gallon
1 ounce = 29.6 milliliters
1 gallon = 3.78 liters

Conversions for general calculations

1 sq mile = 640 acres
1 acre = 43,560 sq ft
1 acre = 0.405 hectare
1 ounce = 28.3 grams
1 pound = 0.454 kilogram
1 inch = 2.54 centimeters
1 yard = 0.914 meter
1 mile = 1.609 kilometers
1 mile = 5280 feet
1 mile/hour = 88 feet/min
Celsius = (F - 32) x .55

For more information on pest management, or for additional copies of this publication, contact the NPM program at 608-265-2660, on the web at http://ipcm.wisc.edu or by mail at 1575 Linden Drive, Madison, WI, 53706. Before publicizing, please call for publication availability. The NPM program is administered by the University of Wisconsin-Extension and the College of Agricultural and Life Sciences, University of Wisconsin-Madison.

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Calibrating a field sprayer (simple math method)

Check for uniform nozzle flow rate. Measure the flow rate of each nozzle by holding a container with volume markings under each nozzle for one minute while the sprayer is operating within the recommended pressure range. Replace or clean nozzles which differ by more than 5% from the average.

Check for uniform spray pattern. Adjust spray boom to the proper height for the nozzle being used. Align flat fan nozzles at a slight angle to the boom. Using clean water, operate the sprayer at a reduced speed but at the desired spray pressure over dry pavement or gravel. Observe the spray pattern as it evaporates. Adjust the boom height if necessary to produce a uniform spray pattern.

Determine spray rate, i.e., gallons per acre.

- ✓ First, fill sprayer tank approximately half full of water.
- ✓ Second, determine travel distance based on nozzle spacing using the following formula: Travel distance in feet = 8160/nozzle spacing in inches.
- ✓ Measure distance to travel in the field and drive the designated distance using the exact throttle setting and gear you plan to use during spraying. Record travel time in seconds.
- ✓ With the sprayer stationary, adjust pressure to the desired setting, collect and record the output in ounces from several nozzles for the same number of seconds determined for travel time.
- ✓ Determine the average nozzle output in fluid ounces. The spray rate in gallons per acre is equal to the average nozzle output divided by two.
  Note: This step is based on a calibration area of 1/64 of an acre and will not work for calibration area of any other size.

Make proper adjustments.
If the calculated spray rate is within the pesticide label's range, your sprayer is calibrated. If not, you must adjust speed, pressure or change nozzle tips. Changing sprayer pressure is useful only if a small change in spray rate is required. A fourfold increase in pressure is needed to double the spray rate. If pressure is kept constant, changing ground speed changes spray rate proportionately. Doubling ground speed of the sprayer will reduce the spray rate by one half.

Calibration equations (alternate method)

$$\text{Speed (MPH)} = \frac{\text{Distance (in feet)} \times 60}{\text{Time (in seconds)} \times 88}$$

$$\text{GPA} = \frac{5{,}940 \times \text{GPM (per nozzle)}}{\text{MPH} \times \text{W*}}$$

*W = Broadcast application => nozzle spacing
= Single nozzle or band applications => spray width
= Directed spray application => Row spacing divided by number of nozzles per row

Adjusting for carrier spray viscosity

Manufacturers of spray nozzles base flow rate on water alone. Conversion factors must be used when spraying solutions which are heavier or lighter than water. Multiply the desired GPA by the appropriate conversion factor (weight or specific gravity) from the table below. Then use the new GPA rate to select the proper size nozzle from the manufacturers' charts.

Example: Desired GPA is 20 gallons. Spray solution is 28% UAN.
The proper nozzle size for applying this spray solution is:

20 GPA x 1.13 = 22.6 GPA

Weight of solution	Specific gravity	Conversion factor
8 lbs. per gallon	.96	.98
8.34 lbs. per gallon - WATER	1	1
9 lbs. per gallon	1.08	1.04
10 lbs. per gallon	1.20	1.10
10.65 lbs. per gallon - 28% UAN	1.28	1.13
11 lbs. per gallon	1.32	1.15
12 lbs. per gallon	1.44	1.20

Adjuvant Rate Conversions

		Spray volume (GPA)		
		20	15	10
Adjuvant rate	Amount/100 gallons	Adjuvant Rate per Acre		
2%	2 gallons	3.2 pints (51.2 ounces)	2.4 pints (38.4 ounces)	1.6 pints (25.6 ounces)
1%	1 gallon	1.6 pints (25.6 ounces)	1.2 pints (19.2 ounces)	0.8 pint (12.8 ounces)
0.5%	2 quarts	0.8 pint (12.8 ounces	0.6 pint (9.6 ounces)	0.4 pint (6.4 ounces)
0.25%	1 quart	0.4 pint (6.4 ounces)	0.3 pint (4.8 ounces)	0.2 pint (3.2 ounces)
0.125%	1 pint	0.2 pint (3.2 ounces)	0.15 pint (2.4 ounces)	0.1 pint (1.6 ounces)

Changing from a broadcast rate to a small volume rate

rate per acre **X** small volume **÷** spray volume **=** **small volume rate**

Example:

1.33 pints/acre **X** 2 gallons **÷** 20 gallons/acre **=** **0.133 pints (2.13 oz)**

Note: The amount sprayed per acre remains the same, i.e., 20 GPA.

Product Volume vs Active Ingredient (a.i.)

Dry formulation

lbs a.i. / acre **X** % a.i. in product (decimal) **=** lbs of product/acre

lbs of product/acre **÷** % a.i. in product (decimal) **=** lbs a.i. / acre

Liquid formulation

lbs a.i. / acre **÷** lbs a.i./ gal of product **=** gal of product/acre

gal of product/acre **X** lbs a.i./ gal of product **=** lbs of a.i. / acre

Pesticide Application Information

Treatment Thresholds for Insect Pests and Weeds of Field Crops

Field Corn Insects

Insect	Treatment Threshold
Armyworm	1 or more armyworms on 75% of the plants or 2 armyworms on 25% of the plants. Average armyworm length must be less than or equal to ¾ of an inch to merit treatment.
Cutworms	5% of plants damaged and larvae are sixth instar or less. See head capsule gauge below.
Corn leaf aphids	50% or more of the plants have more than 50 aphids per plant. Plants are in the late-whorl to early tassel stages.
Corn rootworm beetles	Pollination Protection: Treat before 70% silking if silks are clipped to within ½" of husk. Root Protection: Following corn. When counts average 0.75 beetles per plant during the egg laying period of mid-August to early September of the previous year. Following soybean. Treat corn if yellow sticky trap catches average more than 5 Western Corn Rootworm beetles/trap/day during the egg laying period of mid-August to early September.
Two-spotted spider mite	Active mite colonies on one-third of the leaves on 50% of the plants, or if 15-20% of the leaf area is covered with mites or their damage. Resample the field in 4-5 days after the initial spray to look for adults and nymphs. Respraying may be necessary.

Stalk borer

Corn leaf stage	Percent infested corn at two corn prices to justify treatment: $2.00/bu	$3.00/bu
V1	10%	7%
V2	12%	8%
V3	15%	10%
V4	16%	11%
V5	17%	12%
V6	34%	23%
V7	100%	100%

(Thresholds based on $13.00/acre control costs and 89% control with insecticides.)
Source: Iowa State University.

Seed corn maggot, white grubs, wireworms, hop vine borer and slugs: No acceptable thresholds at this time.

European corn borer (ECB) treatment threshold

For 1st Generation ECB:

Percent of damaged plants, expressed as a decimal value **x** ave number of borers per infested plant [a] **x** .05 loss/borer **x** expected yield (bu/a) **=** **bu/a loss**

bu/a loss x expected price ($/bu) **x** .80 control [b] **=** **preventable loss $/acre**

preventable loss $/acre - cost of control $/acre = gain or loss if treated ($/acre)

[a] Determined by checking whorls from 10 plants.
[b] Assume 80% control for most products; assume 50% control for Asana, Furadan and Lorsban sprays.

For 2nd Generation ECB:

number of egg masses per plant[a] **x** 2 borers/egg mass [b] **x** .04 loss/borer [c] **x** expected yield (bu/a) **=** **bu/a loss**

bu/a loss x expected price ($/bu) **x** .75 control **=** **preventable loss $/acre**

preventable loss $/acre - cost of control $/acre = gain or loss if treated ($/acre)

[a] Use cumulative counts, taken 7 days apart.
[b] Assumes survival rate of 2 borers/egg mass
[c] Use 3% loss/borer if infestation occurs after silks emerge. The potential economic benefit of treatment decline rapidly if infestation occurs after corn reaches the blister stage.

Effect of corn stage of development on predicted yield loss from five weed species.*

Weeds	PERCENT YIELD LOSS				
	Lambs-quarters	Giant Foxtail	Velvetleaf	Crabgrass	Giant Ragweed
Corn stage	----------50 plants /100 ft²----------				10 plants /100 ft²
0-5"	18	16	14	4	11
6-12"	13	11	9	3	7
13-24"	7	6	5	1	4
24"-Tassel	3	3	2	1	2

*Assumes 2-4 inch weed height.

Black cutworm instar gauge

To determine the instar stage of larvae, hold the head between thumb and forefinger, and place on the closest corresponding ruler below.

Instar 3, 1/32 inch
Instar 4, 1/16 inch
Instar 5, 3/32 inch
Instar 6, 1/8 inch
Instar 7, 5/32 inch

Small Grain Insects

Insect	Treatment Threshold
Aphids (Bird-cherry Oat, English grain and Corn leaf)	Seedlings - 30 aphids per stem; Boot to heading - 50 aphids per stem.
Greenbug	Seedlings - 20 aphids per stem; Boot to heading - 30 aphids per stem.
Armyworm	3 armyworms per square foot.
Cereal leaf beetle & wireworms	No threshold established.
Grasshoppers	Treat if grasshoppers average 20/sq yard on field edges or 8/sq yard for a field average. Apply when grasshoppers are small for most effective control.

Soybean Insects

Soybean Aphid

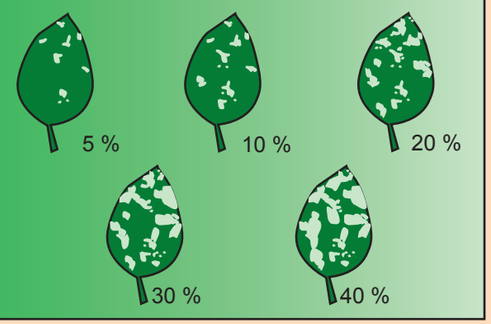
An action threshold of **250 aphids per plant** is advised for fields with an actively increasing population. Determining if a soybean aphid population is actively increasing requires multiple visits to the field.

This guideline incorporates an approximate 7-day lead time between scouting and treatment to make spray arrangements. In replicated trials conducted throughout the Midwest in 2003, a 250 aphids/plant action level worked well from late vegetative through R3 (3/16-inch long pod at one of the four upper nodes) stages. Thresholds for later stage beans continue to evolve.

Growers and consultants are strongly advised to keep current with UWEX publications on soybean aphid scouting tips, a checklist to distinguish actively increasing aphid populations and treatment recommendation updates.

Insect	Treatment Threshold
Grasshoppers, green clover-worms, wooly bear caterpil-lars, and thistle caterpillars	Treat when defoliation reaches 30% in vegetative stage soybeans or 20% in reproductive stage soybeans. See soybean leaf defoliation guide below.
Green stinkbug	Treat when adults and/or nymphs reach one per foot of row during pod fill.
Two-spotted spider mite	Treat when yellowing of the leaves is evident, several leaves have active colonies and damage occurs prior to R6.5-7.0 stages.
Potato leafhoppers	2 per plant with ≤ 3 trifoliate leaves; 6 per plant on flowering soybeans (R1-R2); 13 per plant on soybeans at full pod (R4).
Seed corn maggot	No acceptable thresholds at this time.

Soybean Defoliation Guide



Bean leaf beetle early-season treatment thresholds for soybean defoliation.

Growth Stage		Treatment cost/acre (insecticide + application costs)					
	Crop value	$6.00	$7.00	$8.00	$9.00	$10.00	$11.00
	($/bu)	---------- Number of beetles per plant ----------					
VC	$5.00	2.4	2.8	3.2	3.6	4.0	4.4
	$6.00	2.0	2.3	2.7	3.0	3.4	3.7
V1	$5.00	3.7	4.4	5.0	5.6	6.2	6.8
	$6.00	3.1	3.6	4.1	4.7	5.2	5.7
V2	$5.00	5.9	6.8	7.8	8.8	9.8	10.7
	$6.00	4.9	5.7	6.5	7.3	8.1	8.9

2nd generation bean leaf beetle thresholds in reproductive stage soybean.*

Crop value ($/bu)	Treatment cost/acre (insecticide + applications costs)								
	$7	$8	$9	$10	$11	$12	$13	$14	$15
	---------- Number of beetles per foot of row ----------								
$5.00	5.5	6.3	7.1	7.9	8.7	9.5	10.3	11.0	11.8
$6.00	4.6	5.2	5.9	6.5	7.2	7.8	8.5	9.2	9.9
$7.00	3.9	4.4	5.0	5.6	6.1	6.7	7.3	7.8	8.4
$8.00	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5
	---------- Number of beetles per sweep ----------								
$5.00	3.5	4.0	4.5	5.0	6.5	7.2	7.7	8.3	8.7
$6.00	2.9	3.3	3.7	4.1	5.4	6.0	6.4	6.9	7.3
$7.00	2.4	2.8	3.1	3.5	3.8	4.2	4.5	4.9	5.2
$8.00	2.2	2.5	2.8	3.2	4.1	4.5	4.8	5.2	5.5

Source: Marlin Rice, Iowa State University
* Economic thresholds are based on a row spacing of 30 inches and a plant population of eight plants per foot of row. For narrow-row soybean (8-inch rows) and a plant population of three plants per foot of row multiply the above economic threshold by 0.70

Effect of soybean stage of development on predicted yield loss from five weed species.*

Weeds	PERCENT YIELD LOSS				
	Lambs-quarters	Giant Foxtail	Velvetleaf	Crabgrass	Giant Ragweed
Soybean stage	---------- 50 plants /100 ft²----------				10 plants /100 ft²
VE - V1	41	31	23	8	42
V2 - V3	28	19	14	6	30
V4 - V5	13	9	7	3	14
R1 or greater	6	4	3	1	6

*Assumes 2-4 inch weed height.

Alfalfa Insects (Avoid insecticide applications within 7 days of cutting.)

Insect	Treatment Threshold
Alfalfa blotch leafminer	30 - 40% of leaflets showing pinhole feeding.
Alfalfa weevil	1st Crop: 40% or more of stems showing feeding. 2nd Crop: 50% or more of stems showing feeding.
Meadow spittlebug	1 nymph per stem.
Pea aphid	100 aphids per sweep.
Alfalfa & Tarnished plant bug	3 per sweep on 3" or shorter alfalfa; 5 per sweep on alfalfa taller than 5".
Potato leafhopper	0.2/sweep on 3" alfalfa; 0.5/sweep on 6" alfalfa; 1/sweep on 8-11" alfalfa; 2/sweep on alfalfa taller than 12".

Notes: